Pre-Recover from a Node Failure in Ad hoc Network Using Reactive Protocols

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***Abstract*— Ad-hoc Network is an infrastructure less networks, which will configure by it without any base stations. A mobile ad hoc network will move freely in any direction without any restrictions. Reactive protocol will intimate route discovery only when it wants to send data to the destination. The Sensor will monitor their surroundings and forward the data to the actor nodes. An actor has to coordinate their operations and it is necessary to maintain a strongly connected network topology all the times. Moreover the path between the actors may be constrained to meet latency requirements. However, a failure of an actor may cause the network to partition into disjoint blocks. One of the efficient recovery methodologies is to automatically reposition a subset of the actor nodes to restore connectivity. In this paper, we propose Distributed Routing algorithm relies on the local view of a node that relocates the least number of nodes and provides prefailure intimation before node failure occurs. The performance of Distributed Routing algorithm and Network Topology Management techniques is analyzed and validated through network simulation.**

***Keywords*— Ad hoc Network, network topology, and distributed routing algorithm.**

I. INTRODUCTION

An ad hoc wireless network permits wireless mobile nodes to communicate without prior infrastructure. Due to limited range of each wireless node communication is built between two nodes are usually established through a number of intermediate nodes. The sensors serve as wireless data acquisition devices for the more powerful actor nodes that process the sensor readings and put forward an appropriate response. An actor has to maintain strongly connected network topology all the time to coordinate their operations. Actor usually coordinates their motion so that they stay reachable to each other. However, a failure of an actor may cause the network to partition into disjoint blocks and would violate such a connectivity requirement. One of the effective recovery methodologies is to autonomously reposition a subset of the actor nodes to restore connectivity. Therefore, contemporary schemes found in the literature require every node to maintain partial knowledge of the network state.

In this paper, we proposed Distributed Routing algorithm relies on the local view of a node on the network to relocate the least number of nodes and ensure that no path between any pair of affected nodes is extended. DRA will intimate the before node failure occurs. The problem is defined in two Ways first one is node failure is detected using Distributed routing algorithm and second one are replacing the actor node to recover the failure node using network topology management technique. The main scope of this algorithm is to intimate prefailure before the node getting critical position. If any node is in a critical position in the network whose failure cause the network to partition into disjoint blocks the failed node neighbor that belongs to the smallest block reacts. The performance of DRA and Network topology management are validated both analytically and through simulation.

When an actor node fails the sensor node is used to detect the failure node by using the route discovery and the distributed routing algorithm. The first the route is discovered using the AODV route discovery process after the route is discovered the actor node will send the heartbeat message to its neighbor to check whether the node is active or not. Node failure is detected through the concept of distributing heartbeat messages to all the neighbors, if the reply is failing to come from any neighbor node, then the actor node decides that particular node is getting critical stage. The process of prefailure is detected using the distributed routing algorithm.

Once the failure node is detected our proposed system will work efficiently to recover node from failure. It means replacing another healthy node in place of failure node. The topology of the network is also controlled by Network Topology Management Technique (NTMT). This NTMT decides which of the node should move to replace the failure node. If the node is cut vertex of the network the next root node is deciding to move forward to replace the failure node. When the parent node is moving forward its child node are lost, their links with parent node to overcome this problem we proposed NTMT. Before moving forward the parent node should inform to child nodes how many units it moves forward. After getting information from parent node the child nodes to make themselves ready to move the same unit to overcome the link breaks. This process is handled by the Network Topology management Technique. Finally prefailure is recovered by replacing of healthy actor node to get all the backup of the failed node.

II. RELATED WORK

Several schemes have been proposed for restoring network connectivity and failure detection.

M.Younis and K.Akkaya et al.[2] developed a paper for restoring network connectivity in partitioned WSANs. All of these schemes have focused on re-establishing several links without considering the effect on the length of prefailure data paths. Some schemes recover the network by repositioning the existing nodes, whereas others carefully place additional relay nodes. On the other hand, some work on sensor relocation focuses on metrics other than connectivity and coverage.

A.Abbasi, M.Younis, and K.Akkaya et al.[3] have proposed Distributed Actor Recovery Algorithm(DARA) which is efficient to restore the interactor network that has been affected by the failure of the actor. The two variants of the algorithm are developed to address 1- and 2-connectivity requirement. The idea is to identify the least Number of the actors that should be repositioned in order to re-establish a particular level of the connectivity. DARA aim to localize the scope of the recovery process and minimize the movement overhead imposed on the involved actors.

H.Liu,Leung and R.Du et al.[18] have proposed a simple movement control algorithm. This algorithm emulates the attractive and repulsive force in nature, such that each robot simply follows the resultant virtual force to move. This algorithm gives bi-connected networks under a mild condition and derived bounds on the maximum coverage and the minimum moving distance. Only 1-hop information is used for movement control. This algorithm has very good performance and it is applicable to large networks with many nodes.

S.Das,H.Li,A.Nayak et al.[28] have proposed a localized movement control algorithm to construct a fault-tolerant mobile robot network. The simulation results show the effectiveness of our algorithm and its efficiency in terms of success rate and the total distance travelled by robots. The simulation results are periodically generated connected networks show that our localized movement control algorithm significantly outperforms its globalized counterpart. The use of local information is sufficient to convert the network into a bi-connectivity. The proposed algorithm was successful in the construction of bi-connected network topology.

P.Basu and J.Redi et al.[26] have proposed novel localized movement control algorithm to form a fault-tolerant bi-connected robotic network topology of a connected network. This paper proposed distributed algorithm to identify critical head robots. Simulation results show that the total distance of movement of robots decreases significantly with our localized algorithm is compared with the globalized one. . It gives best work on localized movement control for fault tolerance of mobile robot networks.

III. EXISTING SYSTEM

In Existing system sensor probes their surroundings and forwards their data to actor nodes. It is necessary to maintain a strongly connected network all the times. However, failure of an actor node will cause the network to partition into disjoint blocks. This paper overcomes shortcomings and presents Least-Disruptive topology Repair (LeDiR) algorithm. This algorithm will relocate the least number of nodes and ensures that no path between any pair of nodes is extended. LeDiR imposes no additional prefailure communication overhead. It uses proactive protocols, each node will continuously maintain up-to-date routes to every other node in its network. Routing information is randomly transmitted throughout the network in order to maintain routing table consistency. Hence, if a route has already existed before the traffic arrives transmission occurs without any delay.

IV. PROPOSED WORK

In the proposed system indicates failure of the node before the data has been sent. The problem is defined in two ways first one is failure node detection using Distributed Routing Algorithm and another one is replacing of the actor node to recover the failure node using Network Topology Management technique without extending the path. When the actor node is getting failure the sensor node will detect the failed node by using Routing discovery and the Distributed Routing Algorithm. The first the route is discovered using the AODV route discovery process.

The Ad hoc On-Demand Distance Vector (AODV) routing protocol. When the source node wants to send a message to some destination node. In first route request will be send to all the nodes. Each node will maintain its own sequence number, as well as the broadcast ID. The broadcast ID is incremented for every Route Request (RREQ) the node initiates and together with the node's IP address, uniquely identifies a RREQ. During the process of forwarding the RREQ the intermediate nodes record the route tables the address of the neighbor from which the first copy of the broadcast packet is received, thereby establishing the reverse path. If any additional copies of the same RREQ are later received, that packet is discarded. Once the RREQ reaches the destination or an intermediate node with a fresh sufficient route, the destination or the intermediate node will responds by the unicasting route reply (RREP) packet back to the neighbour from which it first received the RREQ. Again the RREP is routed back along the reverse path, nodes along this path set up forward entries in their route tables which point to the node from which the RREP came. In this paper, we used Reactive Protocols the node initiates the route discovery network, only when it wants to transmit the packets to its destination.

After the route is discovered the actor node will sends the heartbeat message to the neighbors to check whether they are active or not. Failure node is detected through the concept of distributing the heartbeat messages to all the neighbors if node is getting critical stage. Process of prefailure is detected using the Distributed Routing Algorithm. Once the failure node is detected our propose node in the place of failure node. It also considers the network topology problem happens at the time of the recovery process. The topology of the network is controlled by the Network Topology Management Technique. This NTMT decides which of the node should move to replace the failure. If the node is cut vertex of the network the next root node is decided to move forward to replace the failure node. When the parent node is moving forward its child node will lost their links with parent node for that purpose we proposed the NTMT to control over it. Before moving forward the parent node should informs to the child nodes how much units it moves forward. By getting information from the parent node the child nodes are make themselves ready for move the same unit to overcome the link breaks. This process is handled by the Network Topology Management Technique. Finally prefailure is recovered by replacing of healthy actor to get all the backups of the failure node.

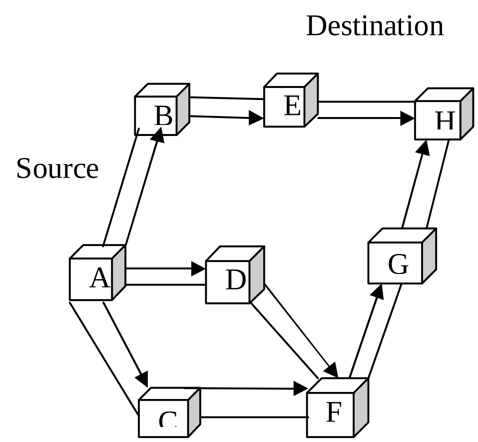
A. Node Deployment

The nodes are deployed in the random manner where the data gathered from all the sensors need to be extracted to base station. The node deployment plays an important role for maintaining the connectivity and coverage.

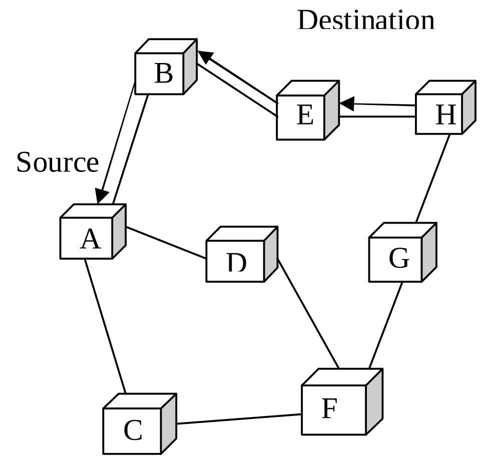
B.AODV Route Discovery

The Ad hoc On-Demand Distance Vector (AODV) routing protocol is intended for use by mobile nodes in an ad hoc network. If offers quick adaptation to dynamic link conditions low processing and memory is overhead, low network utilization, and determines unicast routes to destinations within the ad hoc network. When a node send a packet to some destination, it checks its routing table to determine if it has a current route to the destination. If Yes,
forward the packet to next hop node. If No it initiates a route discovery process to find route to the destination

1) Route Requests (RREQS),
2) Route Replies (RREPS) and
3) Route Errors (RERRS).



(a)Propagation of the RREQ



(b) Path of the RREP to source

C.Failure Detection

Actors will randomly send heartbeat messages to their neighbors to ensure that they are functional and also report changes to the one-hop neighbors.

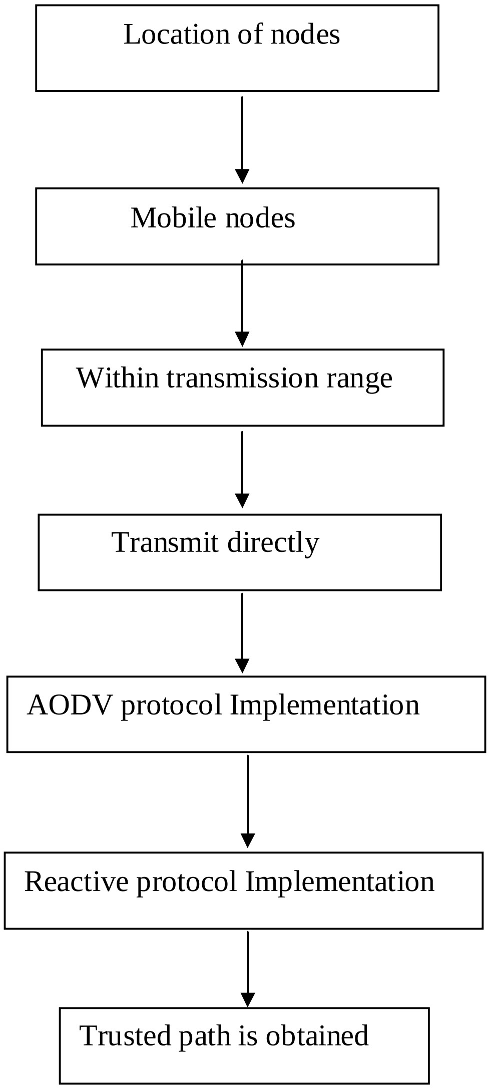


Fig. 1 Architecture Diagram

Missing heartbeat messages can be used to detect the failure of actors. Once a failure is detected in the neighborhood, the one-hop neighbors of the failed actor will determine the impact that is, whether the failed node is critical to the network connectivity. This can be done using the SRT by executing the well-known depth-first search algorithm.

Distributed Routing Algorithm limits the relocation of nodes in the smallest disjoint block to reduce the recovery overhead. The smallest block is the one with the least number of nodes will be identified by finding the reachable set of nodes for every direct neighbor of the failed node and then picking the set with the fewer nodes. Since a critical node will be on the shortest path of two nodes in the separate blocks, the set of reachable nodes can be identified through the use of the SRT after excluding the failed node.

D. Replacing Fault Node

If node J is the neighbor of the failed node that belongs to the smallest block, J is considered the BC (Best Candidate) to replace the faulty node. Since node J is considered the gateway node of the block to the failed critical node and the rest of the network, we refer to it a parent. A node is a child if it is two hops away from the failed node grandchild if three hops away from the failed node, and so on. The reason for selecting J to replace the faulty node is that the small block has the fewest nodes in case all nodes in the block have to move during the recovery. The overhead and convergence time of Distributed Routing algorithm are linear in the number of nodes, and thus, engaging only the member of the smallest block will recover and reduce the overhead. In case of more than one actor fits the characteristics of a BC, the closest actor to the faulty node will be picked as a BC.

E. Distributed Routing Algorithm

When the node J moves to replace the faulty node, so that children will lose direct links to it. Thus the child receives a message that the parent P is moving the child, then notices its neighbors and travels directly towards the new location of P until it reconnects with its parent again.

Distributed Routing Algorithm

```
Data: Source S, Destination D, Failure F, Sensor Sn
Distributed Routing (node S and node D)
BEGIN
FOR each (node S discovered the route it sends the
IF S->Next Hop of the route extends upto D
Heart_Beat_Message (msg);
ELSEIF Next Hop IS NULL
FOR node from D to S should reply to that message
within the given TimeStamp
END FOR
ELSEIF failed to reply within the allocated Timestamp
node considered as the failedNode F
IF node F is a critical position THEN
S passes information about F to Sn;
IF BestCandidate (R);
R replaces the position of F;
Replaced<- True;
BroadCast (Msg (Failure node is recovered));
END IF
END IF
Exit;
END IF

END
ISBestCandidate
Neighbor List [] <- GetNeighbors (F) by accessing
nearer block F in shortest path route for failure;
SmallestBlockSize of Neighbor <- Number of nodes in
the network;
BestCandidate <- R;
FOR each node i in the NeighbourList[]
```

```
Number of reachable nodes<-0;
FOR each node K in shortest route without i and F
Retrieves shortest path from i to k by the using shortest
path route;
IF the retrieved shortest path did not include the node F
No of reachable nodes<- No of reachable nodes+1;
END IF
END FOR
IF Number of reachable nodes  < SmallestBlockSize
SmallestBlockSize <- Number of reachable nodes;
BestCandidate <- I;
END IF
END FOR
IF BestCandidate==R
Return TRUE;
ELSE
Return FALSE;
END IF
```

V. CONCLUSION

Distributed Routing Algorithm will restore connectivity by efficient repositioning of nodes. Distributed Routing Algorithm (DRA) will intimate before the node getting a failure. DRA can recover simultaneous node failures. The performance of DRA is analysed mathematically and validated through Network simulation.

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